P3.7 THE SEASONAL PATTERN OF RECENT CHANGE IN PRECIPITATION NORMALS

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Previous research has identified a general climate trend over much of the contiguous United States towards higher precipitation (Easterling et al., 2000; Karl and Knight, 1998; Hu et al., 1998). This trend is also apparent in the updated precipitation Normals for 1971-2000, and in precipitation averages over the last 10 to 20 years (Garbrecht and Rossel, 2002). Thirty-year normal climate values (WMO, 1986) are generally updated at the end of each decade and are used as a base against which to compare current climate conditions. This study computes annual and seasonal changes in precipitation Normals based on the state divisional monthly precipitation data published by the National Climatic Data Center (e.g. NCDC, 1994) that have been grouped into similar size regions corresponding to the NOAA forecast divisions. The delineation of forecast divisions can be found at http://www.cpc.ncep.noaa.gov/pacdir/NFORdir/HOME3.html.

On average over the contiguous United States, the current annual precipitation Normal is about 4% higher than the 1895-2001 average precipitation. Furthermore, it appears that while the annual precipitation Normals were relatively stable at the beginning of the 20th century, they began to increase at the end of the 20th century during the 1961-1990 and 1971-2000 Normal periods. About two thirds of the contiguous Unites States experienced the highest Normals during the 1971-2000 period. Of this two third of the United States, about half showed an increase in precipitation Normals between 5 and 10 percent, and 7 percent showed an increase above 10 %. This increase in precipitation Normals is not uniformly distributed across the contiguous United States. Annual precipitation Normals (1971-2000) increased for the Great Plains, Midwest, New England, Mid Atlantic, Southwest, and Intermountain Basin regions, whereas little or no change occurred in California, Southern Nevada, Florida, Georgia, and in the Northern and Central Rocky Mountain region. Regions with decreasing precipitation were very few and scattered through the western United States.

The seasonal distribution of changes in precipitation Normals is more relevant than annual values for applications relating to the hydrologic cycle and water resources management. On average over the entire contiguous United States, the fall and winter seasons experienced a 5.9% precipitation increase during 1971-2000 over the long-term 1895-2001 average precipitation, whereas spring and summer only saw a 2.6% increase. The distribution of the changes in seasonal precipitation Normals for the 1971-2000 period over the contiguous United States was also highly varied. During the winter months (January, February and March) the Southwest, the Great Plains and the Southeast showed a strong increase in precipitation Normals, and the Northern and Central Rocky Mountain regions and portions of the Midwest showed a general decrease. During the spring months (April, March and June) the Appalachian Mountains and Coastal Oregon and Washington showed a moderate increase in precipitation Normals, whereas the Northern Rockies and the most northern Plains States experienced a moderate decrease, with California, Nevada experiencing a strong decrease. During summer months (July, August and September) California, Oregon and parts of Nevada, Washington and Idaho had a strong increase in the precipitation Normals, whereas only the southern portions of Nevada and the Southeast were drier. Finally, most of the contiguous U.S. east of the Rocky Mountains and the Southwest experienced a strong increase in precipitation Normals during the fall (October, November and December), and California and parts of Oregon, Washington and Idaho were generally drier.

Three salient features are worth noting. First, for most regions the spatial pattern of annual precipitation Normals is not necessarily indicative of the seasonal pattern. For example, portions of the Southwest show no change in annual precipitation Normals, yet the Normals for the winter season are wetter and those for the summer season are drier. The situation is similar for the Northern Rockies and the Northern Central Plains, where spring season precipitation Normals have decreased but fall season Normals have increased. Second, the West Coast and Sierras show a strong increase in summer precipitation for the 1971-2000 Normal period. In California and southern Nevada region these wetter summer season Normals are bracketed by drier spring and fall season Normals. Finally, the increase in annual Normals for the Southwest, the Central Plains and most of the Southeast can be attributed mostly to wetter fall and winter season Normals.

These seasonal changes in precipitation Normals have many hydrologic and water resources management implications. For example, in drier climates, urban, industrial and agricultural water supply is often dependent on seasonal water storage, which in turn may require additional storage capacity and adjustments to reservoir storage-release operations to account for the seasonal change in precipitation. Similarly, the drier fall and spring in the central and southern Sierras may reduce the snow pack accumulation that feed numerous reservoirs that supply water to large urban and agricultural areas. Even though summer precipitation Normals have increased along the western coast, it must be recognized that a strong relative increase in summer precipitation may not translate into an absolute precipitation amount that makes a relevant difference for practical water supply/need applications. Last, for many regions, changes in annual and seasonal precipitation Normals may be strong enough to question the customary assumption of climate stationarity in the assessment of expected conditions or risk. The climate variables of the first half of the 20th century may not appropriately reflect conditions that prevailed in more recent decades. This has implications for the use of weather generators that are based on long-term average climate data. Another possible impact is related to the analysis and optimization of dryland farming strategies and production, which are designed around and dependent on seasonal water availability. Given the magnitude of these trends, analyses and operational methodologies based on assumptions of climate stationarity, such as reservoir operation strategies, streamflow regulations, environmental sustainability and ecosystem climax, should be carefully re-examined in light of the changing seasonal pattern of precipitation Normals.

References

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Change in Annual Precipitation Normals (1971-2000)

in Percent of Long Term Average (1895-2001)

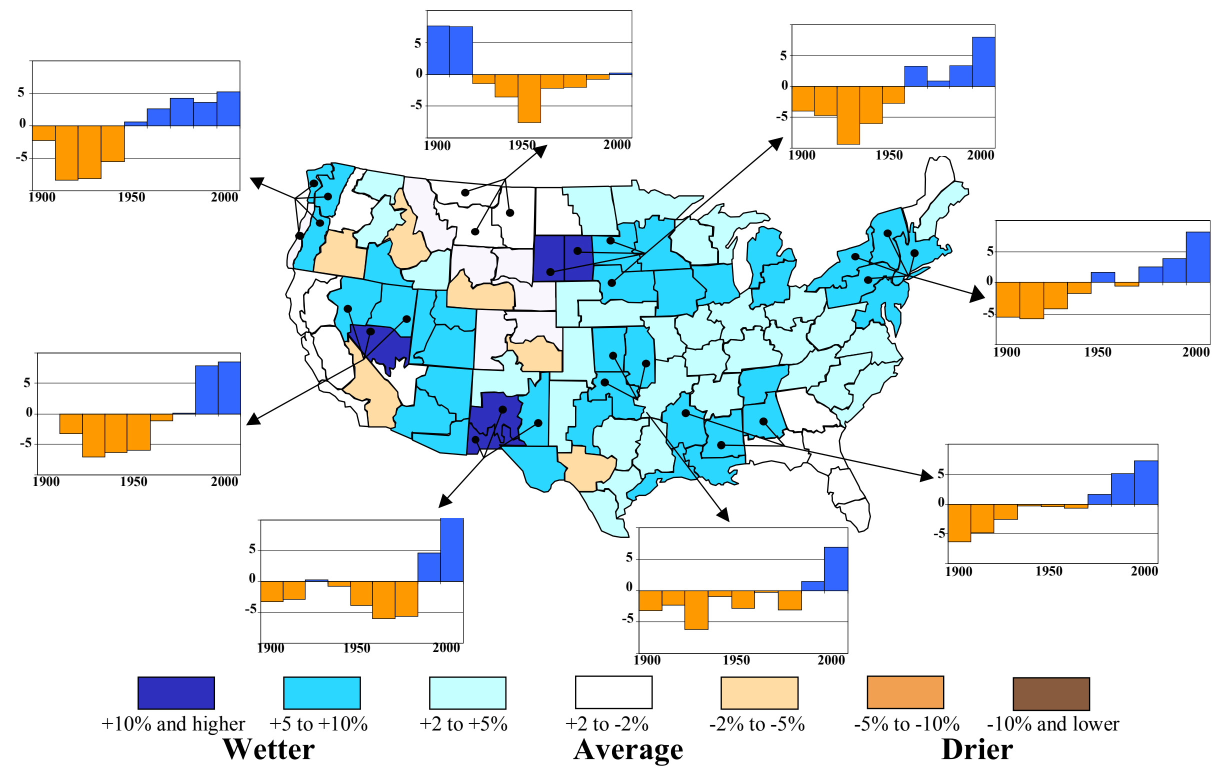

Figure 1. Change in annual precipitation Normals (1971-200) in percent of long term average (1895-2001).

Departures of Seasonal Precipitation Normals (1971-2000)

in Percent of Long Term Average (1895-2001)

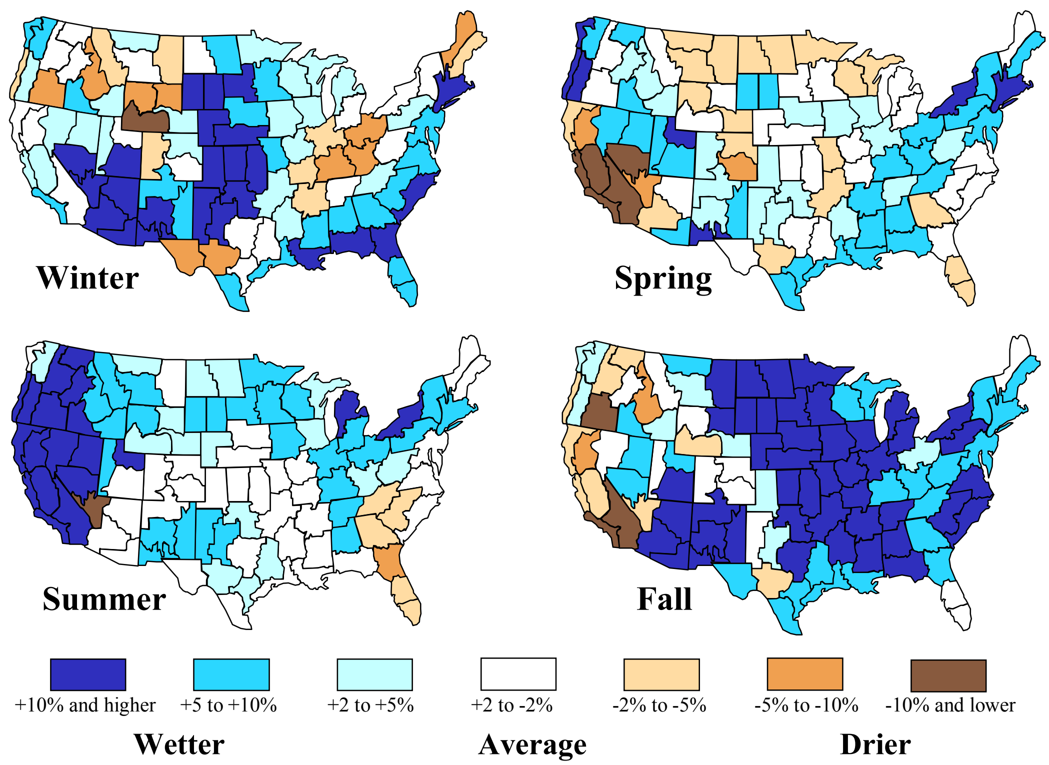

Figure 2. Departures of seasonal precipitation Normals (1971-2000) in percent of long term average (1895-2001)